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Soybean aphids and K-deficient soybeans: Why are there aphids in my field and not my neighbor's?

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Soybean aphids and K-deficient soybeans: Why are there aphids in my field and not my neighbor's?

by Matt O'Neal, Department of Entomology

There were frequent reports of fields infested above 250 soybean aphids per plant adjacent to those with lower populations that never reached threshold. The lowest aphid populations were seen in the southern tier of Iowa counties. However, Mark Carlton, extension field crop specialist in southeast Iowa, called me several times during the season to report that he had scouted fields that were above threshold. By the third call, it became a bit of a routine, with each field sharing some remarkable similarities. All these soybean fields were planted in either alfalfa or sod in 2004. This is interesting since soybeans following alfalfa often suffer from potassium deficiency. And to complete the puzzle, recent research conducted at the University of Wisconsin and Michigan State University indicates that soybeans grown in potassium-deficient soils may be more at risk for soybean aphid outbreaks. What follows is a brief explanation of why soybean aphids reproduce faster on K-deficient soybeans.

But before I get to the K-deficient soybeans, let's consider the feeding habits of soybean aphids. This species is like most aphids: they get all of their nutrition from one source--the phloem of a single species of plant. To put this in some perspective, their meat, potatoes, and dessert are all taken from one source. Since phloem is low in vital nutrients, like nitrogen, it is thought that the aphids make up for this apparently unbalanced diet by ingesting a lot fluid to get all the nutrients they need to grow and reproduce. Any excess fluid and sugar may contribute to the honeydew that aphids shed while feeding on plants.

Given the low concentrations of nitrogen in the phloem of most plants, changes in its concentration can have dramatic changes in aphid growth and reproduction. For most aphid/plant interactions, the greatest amount of nitrogen in phloem corresponds to two periods in a plant's life--vegetative growth and senescence. These are times when nitrogen is flowing in the plant, moving to growing leaves or shuttled from senescing leaves. These are also times when aphids tend to grow and reproduce in the greatest number. Between these periods of robust growth, the amount of nitrogen available in the phloem is not as great. This may explain why soybean aphids look "anemic" or "whitish" in late July and early August since soybean vegetative growth is completed and the availability of nitrogen in the phloem may be limited.

Another factor that can influence nitrogen availability is stress. One type of stress that has been shown to favor aphid growth is K-deficiency. Recently, a group of entomologists at

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the University of Wisconsin showed that aphids on K-deficient soybeans produce 39 percent more nymphs than on healthy plants. In a separate study, Chris DiFonzo and her graduate student Abigail Summers at Michigan State University have shown that the amino acid profile in K-deficient soybeans contains a greater amount of amino acids that aphids need for optimal growth. So it appears that although a K-deficient plant is stressed, it is a better host for soybean aphids than a healthy plant.

To what extent this contributes to local differences in soybean aphid populations is not yet clear. There are potentially several plant-stress factors that could lead to similar changes in soybean health and subsequent aphid population growth. For example, Greg Tylka, extension nematologist and plant pathologist; Felicitas Avendano, researcher; and I are collaborating to determine if soybean cyst nematodes also stress soybeans in such a way as to exacerbate aphid population growth. We hope to identify factors that would increase the likelihood of soybean aphid outbreaks and help growers better predict what fields may be at risk for economic populations.

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